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10/713,762

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08/08/2006

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EXAMINER

PHAM, THANHHA S

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 08/08/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

| | | | |
|------------------------------|--------------------------------------|---|--|
| Office Action Summary | Application No. 10/713,762 | Applicant(s) CHENG, YANG CHIN | |
| | Examiner Thanhha Pham | Art Unit 2813 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 22 May 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1, 2, 8-12, 17-19, 21-24, 27-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 27 and 28 is/are allowed.
- 6) ☒ Claim(s) 1-2, 8-12, 17-19, 21-24, 29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

This Office Action is in response to Applicant's Amendment dated 5/22/2006.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

1. Claims 17-18, 21-24 are rejected under 35 U.S.C. 102(b) as being anticipated by Tseng [US 6,429,123].

Tseng (figs 1-13, cols 1-5) discloses the claimed method comprising:

providing a substrate (10, fig 1) having a first layer (12/14) formed thereon;

forming a second layer (16, fig 1) on the first layer;

performing a treatment on the second layer (16, figs 1-2, col 3 lines 56-67 & col 4 lines 1-11) to form at least part of the second layer into separate structures (20, fig 2) having first distances between corresponding points of the separate structures defining a first pitch, and forming a protection layer (22, fig 2, col 4 lines 13-18) over the second layer, the treatment comprises a flood exposure (figs 1-2, col 3 lines 56-67 & col 4 lines 1-11: *using photolithography technique to form the separate structures 20 would inherently using a*

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flood exposure), the protective layer comprises a silylated layer (polysilicon 22) inherently formed by performing in a gas phase or a liquid phase;

removing a first portion of the protection layer to expose the second layer (figs 2-3), the removing the first portion of the silylated layer (22) to expose the second layer comprises using an etching back/dry etching process or a chemical mechanical planarization/wet etching process (col 4 lines 19-25), the removing of the first portion of protection layer of the silylated layer does not remove a substantially portion of the second layer (20, fig 3) ;

removing the second layer (20, fig 4) to form at least part of the protection layer into separate protection structures (24) having second distances between corresponding points of the separate protection structures defining a second pitch less than the first pitch, the removing of the second layer comprises using a dry stripping process or a wet stripping process (col 4 lines 26-37), the removing the second layer does not remove substantially portion of the first layer (12/14);

using the separate protection structures (24, fig 9-10) as an etch mask, removing an exposed portion of the first layer (12/14); and

removing the separate protection structure (24, figs 10-11).

2. Claims 1 and 17 are rejected under 35 U.S.C. 102(e) as being anticipate by Rottstegge et al [US 2003/0091936].

► With respect to claim 1, Rottstegge et al (figs 1's, text [0001]-[0056]) discloses the claimed method for forming a semiconductor device comprising steps of:

providing a substrate (1) and forming a material layer over the substrate (text [0045] & [0035]: *silicon wafer substrate covered with a layer of silicon dioxide*);

forming a photoresist layer (photoresist layer to form webs 3, fig 1(a), text [0045], [0008]-[0013]) over the material layer;

exposing a top surface of the photoresist layer to a treatment radiation to generate separate photoresist structures (3, fig 1(a), text [0045]) having first distances between corresponding points of the separate photoresist structures defining a first pitch;

forming a protectant layer (6/7, fig 1(b), text [0046]) over the separate photoresist structure;

removing a portion of the protectant layer to expose an underlying portion of the photoresist layer (fig 1(c));

removing the photoresist layer (fig 1(d)) to form at least part of the protectant layer into separate protectant structures (6, fig 1(d)) having second distances between corresponding points of the separate protectant structures defining a second pitch, the second pitch being less than the first pitch;

removing portions of the material layer (text [0047]: *structure being transferred to the substrate 1 by selective etching process, uncover parts of the substrate being removed*)

► With respect to claim 17, Rottstegge et al (figs 1's, text [0001]-[0056]) discloses the claimed method for forming a semiconductor device comprising steps of:

providing a substrate (1) having a first layer formed thereon (text [0045] & [0035]: *silicon wafer substrate covered with a layer of silicon dioxide*);

forming a second layer (photoresist layer to form webs 3, fig 1(a), text [0045], [0008]-[0013]) on the first layer (first layer of silicon oxide on the silicon wafer);

performing a treatment on the second layer to form at least part of the second layer into separate structures (3, fig 1(a), text [0045]) having first distances between corresponding points of the separate photoresist structures defining a first pitch, and forming a protection layer (6/7, fig 1(b), text [0046]-[0047], [0056]) over the second layer (3);

removing a first portion (7, figs 1(b)-1(c)) of the protection layer to expose the second layer;

removing the second layer (figs 1(c)-1(d)) to form at least part of the protection layer into separate protection structures (6, fig 1(d)) having second distances between corresponding points of the separate protection structures defining a second pitch, the second pitch being less than the first pitch; and

using the separate protection structures (6, fig 1(d)) as an etch mask, removing an exposed portion of the first layer (text [0047]: *structure being transferred to the substrate 1 by selective etching process, uncover parts of the substrate being removed*)

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 2, 8-11, 18, 21-24 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rottstegge et al [US 2003/0091936] in view of Liao [US 6,294,314].

► With respect to claims 2, 8, 10-12, 18 and 29, Rottstegge et al substantially discloses the claimed method including:

- the treatment radiation comprising light radiation (text [0045]) wherein the photoresist layer being positive photoresist (text [0045], [0016]) and wherein the exposing of photoresist performing a flood exposure process of alter at least one property of the photoresist layer,
 - the protectant layer comprises a silylated layer (text [0047], [0056]), wherein the forming a silylated layer over the separate photoresist structures comprises silylanizing a surface of the photoresist structure
 - the material layer (e.g. silicon dioxide) is selected form the group consisting of silicon, silicon dioxide, doped silicon dioxide, silicon nitride, poly silicon, aluminum, copper, titanium, titanium nitride, tantalum and tantalum nitride
- Rottstegge et al does not expressly teach removing the separate protectant structures after using the separate protectant structures as the mask.

However, Liao teaches removing the separate protectant structures (110a) after using the separate protectant structures as the mask.

Therefore, at the time of invention, it would have been obvious for those skilled in the art, in view of Liao, to modify process of Rottesgge et al by removing the separate

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protectant structures after a usage for masking to complete a patterning process in manufacturing the semiconductor device.

► With respect to claim 9, positive e-beam photoresist is a known material for forming the photoresist layer in process of fabricating semiconductor device. Selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig-saw puzzle." 325 U.S. at 335, 65 USPQ at 301. See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960) (selection of a known plastic to make a container of a type made of plastics prior to the invention was held to be obvious).

► With respect to claims 18, 21-24, Rottestegge et al substantially discloses the claimed method including:

- the treatment comprise a flood exposure
- the protection layer comprises a silylated layer (text [0047], [0056]), wherein forming a silylated layer comprises silylanizing the second layer in a gas phase or in a liquid phase
- the removing the first portion of the silylated layer to expose the second layer comprises using an etching back/dry etching process or a chemical planarization process/wet etching process, the removing the first portion of the silylated layer does not remove a substantial portion of the second layer

- the removing the second layer comprises using a dry stripping process or a wet stripping process, the removing the second layer does not remove a substantial portion of the first layer.

Rottestegge et al does not expressly teach removing the separate protection structures after using the separate protection structures as the etch mask.

However, Liao teaches removing the separate protectant structures (110a) after using the separate protectant structures as the mask.

Therefore, at the time of invention, it would have been obvious for those skilled in the art, in view of Liao, to modify process of Rottessgge et al by using removing the separate protection structures as being claimed after a usage for masking to complete a patterning process in manufacturing the semiconductor device. In regarding to claims 23-24, those skilled in the art would recognize that, after removing the separate protection structures, a plurality of structures being formed in the first layer of the substrate would have a pitch that is smaller than a photolithography process will allow and a substantial portion of the substrate would not be removed to provide the substrate/base for semiconductor device.

4. Claims 12 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rottsgge et al [US 2003/0091936] in view of Liao [US 6,294,314] as applied to claims 11 and 18 above, and further in view of Mimura et al [US 4,751,170].

Rosttsgge et al in view of Liao substantially discloses the claimed method including performing the treatment using ultraviolet radiation on the resist layer/the second layer of the photoresist layer to form the separate photoresist structures and

forming the protection layer of the silylated layer over the separate photoresist structures.

Rosttge et al in view of Liao is silent about using the ultraviolet radiation substantially perpendicularly to the second layer of the photoresist layer and silylanizing the separate photoresist structure in a gas phase.

However using the ultraviolet radiation substantially perpendicularly to the second layer of the photoresist resist layer so that a top surface of the second layer of the photoresist layer being exposed to the ultraviolet radiation and silylanizing the separate photoresist structure in gas phase are known technique for treating and silylanizing the photoresist. See Mimura et al (fig 2, cols 1-14 more particularly col 12 lines 8-30) shows treating the patterned photoresist by using the ultraviolet radiation substantially perpendicularly to the patterned photoresist so that the top surface of the patterned photoresist being exposed to the ultraviolet radiation and silylanizing the photoresist layer in gas phase.

Therefore, at the time of invention, it would have been obvious for those skilled in the art to modify process Rottstegge et al in view of Liao by treating the photeresist layer and silylanizing the separate photoresist structures as being claimed as known techniques per taught by Mimura et al to provide the silylated layer on the photoresist layer for forming structure with reduced pitch as demanded in device.

Allowable Subject Matter

5. Claims 27-28 are allowed.

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6. The following is an examiner's statement of reasons for allowance: Recorded Prior Art fails to disclose or suggest the combination of the process steps of forming a semiconductor device having a reduced pitch as recited in the base claim 27 including exposing the patterned photoresist layer to ultraviolet radiation to alter at least one property of the patterned photoresist layer so that a cross-link degree of a portion of the patterned photoresist layer is reduced; silylanizing the patterned photoresist layer in a gas or in a liquid phase by diffusing silylamine into the patterned photoresist layer and forming a silylated layer over the surface of the patterned photoresist layer; removing a first portion of the silylated layer to expose the patterned photoresist layer using an etching back process or a chemical planarizing process; removing the patterned photoresist layer using a plasma gas to form at least part of the silylated layer into separate silylated structures having second distances between corresponding points of the separate silylated structures defining a second pitch, the second pitch being less than the first pitch; using the separate silylated structures as an etch mask, removing an exposed portion of the material layer; and removing the separate silylated structures thereby forming a plurality of separate material structures having the second pitch, which is smaller than a photolithography process will allow.

Response to Arguments

7. Applicant's arguments with respect to claims 1-2, 8-12, 17-19, 21-24 and 29 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanhha Pham whose telephone number is (571) 272-1696. The examiner can normally be reached on Monday and Thursday 9:00AM - 9:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for

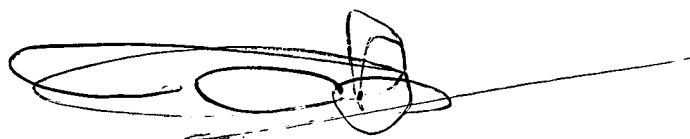
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published applications may be obtained from either Private PAIR or Public PAIR.

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For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

TSP

A handwritten signature in black ink, consisting of several loops and a long horizontal stroke extending to the right.

THANHHA S. PHAM
PRIMARY EXAMINER